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AUTHOR Hirschbuhl, John J.
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ABSTRACT

An overview of issues in the utilization of computer assisted instruction (CAI) in higher education, this document provides (1) a rationale for utilizing CAI; (2) the identification of administrative, faculty, and computer center support required to launch and sustain a CAI effort; (3) an analysis of cost effectiveness issues related to CAI; and (4) speculation about the future of CAI, including a discussion of the possible relationship between CAI and the videodisc. Appended are questions which should be asked when getting started with CAI. (Author/STS)

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BLUEPRINT for the FUTURE of COMPUTER BASED INSTRUCTION

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John J. Hirschbuhl

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

JOHN J. HIRSCHBUHL, Ph.D
Director of
COMPUTER ASSISTED INSTRUCTION
The University of Akron
Akron, Ohio

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INTRODUCTION

THE CHALLENGE TO HIGHER EDUCATION

As the computer increases in its capabilities, its shadow is cast in ever-extending directions across the broad face of society. As this phenomena continues to influence each facet of society, it becomes increasingly important for educators to understand and use the computer to extend the educational capabilities of today's schools. No longer can the education industry afford to allow the fields of engineering and accounting to dominate the computer scene. Educators must develop, within all of their students, the necessary computer literacy and skills that will enable them to accept their responsibility and rightful place in today's computerized society. Such skill-development is a basic requirement for meeting the challenge of getting today's generation of college students ready for its mighty task of leading society into the beginning of the twenty-first century.

One way of meeting the responsibility of preparing the twenty-first century man for his place in that future society is through the use of computer-assisted instruction, CAI.

WHAT IS CAI?

Computer-Assisted Instruction is a supplementary classroom tool that helps teachers teach more effectively. It is a system that enables many students and a single teacher to engage in a one-to-one dialogue, using a high-speed digital computer as the communication medium. Because of this, instruction becomes a two-way communication system that enables the teacher to monitor progress and tailor instruction to fit a student's needs. It accomplishes this mighty task by enabling the instructor to deliver an appropriate instructional move at the precise moment when a particular instructional action is needed. This is a truly remarkable phenomenon. In fact, it is an individualized type of instruction that we have not yet been able to completely understand. There are some who believe that we who use CAI are standing on the edge of something deep. Perhaps it is a phenomenon in search of a theory!

Perhaps, this phenomena known as CAI, is the vehicle needed to provide today's generation with safe passage into the twenty-first century.

WHAT CAN WE LEARN FROM THIS PAPER?

What follows in this paper is a rationale for description of how one of Ohio's larger State Universities brought CAI into existence at their institution.

It is hoped that the reader of this paper will, upon completing its contents, be aware of the benefits and responsibilities that result from the implementation of CAI as an instructional tool. This paper contains a full compendium of such outcomes as well as a peek into the future.

GENERAL OBJECTIVES

The following objectives have been used to outline the succeeding material. Both the scope and sequence of these directives were followed in organizing the material that follows. The objectives are put forth here so that the reader might use them as an advanced organizer for the reading and analysis of this paper.

OBJECTIVES

1. The rationale for utilizing CAI in any one of its numerous forms at the university level.
2. The identification of the administrative, faculty, and computer center support required to successfully launch and sustain a computer-based instructional system.
3. An identification of what cost effectiveness is in my terms, and what factors should be considered in examining cost/benefits ratio.
4. A perspective of where I believe computer based instructional technology is going, and what will be required to get it there.

What follows in sections I through V speaks to each of the above objectives in the order that they have been stated.

1. THE RATIONALE FOR UTILIZING CAI IN ANY ONE OF ITS NUMEROUS FORMS AT THE UNIVERSITY LEVEL.

A. The following 10 items represent the writer's understanding of the rationale for supporting CAI at the university level. Although there are direct cost benefits to be eventually gained by support of such a system, the comments on these benefits are not put forth in this section. What follows in this part is the rationale for achieving such benefits as a result of providing a system that is of great benefit to the clientele that we serve. The benefits are as follows:

1. Open enrollment has changed the college population from a select group of intellectually talented students to a population that is more representative of America's general intellectual ability. Hence, there is a growing number of students who are somewhat limited in their ability to meet the level of intellectual vigor that most universities desire as a matter of maintaining standards.

2. The increased use of the large lecture hall and the T.V. lesson have depersonalized and played down the need for interaction between the instructional agent and the student. CAI enables many students and a single teacher to engage in a one-to-one dialogue.

3. The great dependence on the Full Time Equivalent as a measure of the degree of financial support that a state university will receive makes it imperative that

such institutions prevent academic failures and, at the same time, not lower academic standards.

4. The need to be able to systematically collect and analyze data on student performance on a day-to-day basis so that instruction can be fine-tuned to deliver optimal results with the students for whom it is intended.

5. To provide an instructional medium that allows for a wide variety of instructional action on a given set of instructional objectives, so that the variables assigned to the classical learning situation can be manipulated in such a way as to make achievement constant and allow time spent on instruction to vary.

6. To do things that would normally not be done unless they were undertaken by a University. Remember, universities have a responsibility to create new knowledge to benefit the society they serve.

7. To give the next generation of leaders the opportunity to experience the benefits of the major technological development of the twentieth century, so that they will have a higher probability of developing a more advanced technology for the twenty-first century.

8. To help the University become the hub of a life-long learning resource that meets the demands of the community it serves. In its time frame and learning style through an interactive system that guarantees that, they, the students of the system will have meaningful input into the instructional actions of which they take part.

9. To bring the University and the community closer together through interaction with CAI by community groups such as Upward Bound, Juvenile Detention Centers, and those who believe in life as a form of continuing education.

10. To provide a computer literacy to a majority of this and the next generation that will help them to enjoy the benefits of the computer rather than fear and avoid it.

The above 10 points form a major subset of the rationale for utilizing CAI at the University Level. There are hundreds of other reasons for using such a device but time and space prohibit their inclusion. Suffice to say, any university not now making use of CAI, should seriously re-evaluate its position with respect to this dynamic instructional aid.

II. THE IDENTIFICATION OF THE ADMINISTRATIVE, FACULTY AND COMPUTER CENTER SUPPORT REQUIRED TO SUCCESSFULLY LAUNCH AND SUSTAIN A COMPUTER-BASED INSTRUCTIONAL SYSTEM.

B. The next three sections B, C, and D define the necessary support and tactical moves needed by an institution seeking to initiate and stabilize a production level CAI environment.

REQUIRED ADMINISTRATIVE SUPPORT

The adminstration must:

1. Demonstrate a willingness to listen to and consider the merits of new and innovative ideas.

2. Provide an Educational Research and Development facility that is directly responsible to the President for the collecting of new and innovative approaches to instruction, and provide some "venture" funds to support the development and testing of such ideas.

3. Request the formation of a subcommittee of the University Computer Usage Committee, whose purpose would be to carefully weigh and propose objectives and/or methods of implementing a new approach to instruction by means of the computer. Furthermore, this subcommittee should interact with the Computer Usage Committee while in the process of developing a phased proposal that would define the phased development of an in-house CAI facility for the entire University and the surrounding community.

4. Encourage the subcommittee to develop a broad set of objectives that are not technical or detailed, but are of an over-all educational type; perhaps they should be called goals. These goals must be supported by the administration, and therefore, should be jointly arrived at through the combined efforts of the subcommittee and the University's highest level administrators. Such goals should be used as guidelines for setting up the initial thrusts into the instructional use of computers as part of the University's academic support system.

5. Request creation of a task force committee, which has its members selected from the academic faculty, the computer center, and the Computer Usage Committee. This committee should work directly with the administration and the Educational Research and Development Center. The purpose of their efforts will be to discuss the need for and the means of implementing CAI at the University, within the previously defined guidelines.

6. Be willing to staff a CAI installation with professionals from education and the computing professions.

7. Formulate procedures that give faculty the impression that the idea for a CAI facility originated with the faculty, and that the administration needs to be convinced of the need for CAI.

8. Resist the installation of the needed equipment, but this resistance should only be token resistance, (for about 4 or 6 months). This slight resistance will cause the faculty to refine their position, improve it, and firmly believe that they fought for, explained and won their idea. Since it is their idea, they will do their best to see that once the program is started it will be a success.

9. Be willing to commit planning and financial resources on a longer term than is usually the customary practice for experimental type instructional programs.

10. Have the ability to find and hire a "spark plug" professional who has a background in CAI, and a commitment to it that will cause him to pursue the development of a CAI center in spite of stiff resistance from all sides. To do this the individual must be given some release time and financial support.

11. With faculty help, determine the type of uses that CAI terminals will be put to, and establish this as an initial frame of reference for the potential CAI resource person to operate out of. i.e., is it a production use or an experimental resource laboratory that they want developed. (Part of goal development)

12. Provide direction for the computer center managers, so that computer center management can support the staffing requirements for CAI without fear of allocating their resources to a dead-end project. This implies that the adminsitration be certain of its commitment to CAI before it encourages some sure-footed beginner to spend time and talents laboring in the development of such a project.

13. Make provisions for, and strongly support, the professional growth of those professionals who dedicate themselves to the initiation and steady growth of such a project.

14. Be candid and supportive of the individual in whom they place their trust for the development of this venture. Without support, praise, and promotion, such an individual might lose heart in the long struggle that one faces with such a real time system.

C. REQUIRED FACULTY SUPPORT

1. Faculty from several colleges must be interested in making application of CAI to their curriculum. Support from faculty can be enhanced by field trips to institutions which already have a CAI facility operating. Be sure to investigate several different types of configurations, at various institutions. i.e., large systems, mini systems, clustered terminals, distributed networks etc.

expands and becomes a permanent part of the University program, the budget for such things as terminals, communications support and all other clerical and support materials, should be made a part of CAI center's budget. In the initial stages budgetary transfers from the CAI account to the computer center account should be made by means of normal budgetary transfer procedures.

3. The computer center must supply advice as to what hardware is truly compatible with the existing system. Its director must be part of all discussions and transactions that involve vendors. It is important to remember that the computer center staff is as much a part of the CAI operation as the CAI staff itself.

4. The computer center personnel must be made aware of the need to deliver reliable computer hardware and software support. A batch environment approach to computing operations will not be sufficient to support CAI. Any down time, as little as 5 minutes, has a dramatic effect on the body of users seated at the terminals.

5. The computer operations staff must be responsive to hardware problems that arise, and must be prepared

to deal immediately with the problems. Recurring problems must be identified and corrected and there must be a prevailing atmosphere of watchful waiting, for new problems to develop.

6. There must be a commitment by the computer center management and staff that all systems support software is well documented and that maintenance procedures are not only routine but well documented.

7. The computer center must establish well-regulated procedures for the handling of data collected on CAI. Tape library files must have clearly defined storage times and a two-way communications system between those responsible for such files, must be set up with the CAI staff.

8. There must be a person in the computer center who is responsible for the coordinating of all CAI actions, from programming to operations. This person must be both knowledgeable and personable because this person will have to deal with CAI operators such as the CAI director and individual members of the computer center. This is a tread-lightly-but-surely job. This person must be a computer person who is genuinely interested in the use of computers in instruction.

II. What follows in this section is a series of first moves that should be taken by the person who accepts the responsibility of initiating and directing future CAI activities on campus. Please note that this is an artful as well as scientific task.

E. ELEMENTS NEEDED TO ACHIEVE NECESSARY SUPPORT FROM ADMINISTRATION, FACULTY, AND COMPUTER CENTER FORCES

1. The person seeking to establish CAI on a University campus must make the time to have frequent, informal meetings and discussions with interested administrators, faculty and computer center personnel. The main objective of these meetings should be the planning of strategy to overcome or minimize the opposition that is sure to arise from some members of the University community. (There are always a few members of the University staff who will be opposed to the concept of interactive computing.)

2. There is a need for frequent communication between the initiators, and individuals who profess an interest in the use of computers for instruction. Discussions, both formal and informal, among people who have a common interest in the use of computers in the educational process should be held at least once a month (parties at the intended coordinator's home can help).

3. The future director, with the aid of outside recommendations, should select three people who have a wide distribution of skills for the initial Task Force Committee. Their backgrounds should be varied and they should be well liked by their peers. A computer background is not a requirement, but a desire to meet educational objectives by means of supplementary computer support should be a required element in each team member's value set.

4. The future director, with the help of a Task Force Committee and outside consulting help, should focus on identifying a set of parameters, that will distinguish one set of specific learning problems from another and help define the proper formula for solution of such problems. As a part of the identification process, a set of people should be identified on the basis of three factors:

   a. technical and educational expertise

   b. pronounced skills in dealing with other people, i.e., these people must have a personality factor that causes them to be viewed by others as non-threatening, particularly as the changes wrought by CAI begin to be felt

   c. the unbiased recommendations of outside consultants.

5. The future director should have access to, and a good relationship with, students who have a desire to work in an interactive computer environment or who wish to learn to use computers in the education industry. This person should have the ability and the facilities that are needed to train such people in the workings of CAI. Once training begins such students can be employed as student assistants to help monitor the activities of the CAI center. A CAI operation requires continuous monitoring of the terminal area by dedicated, informed personnel who can correct immediate problems and give users assistance at the terminals. This key factor in a successful operation of a CAI center should not be taken lightly. It is from successful operation that continuing support is acquired. The successful operation requires dedicated user assistance.

6. The CAI staff should conduct periodic seminars on the design techniques and programming language used to create CAI courses. Memos to interested faculty should be used to publicize the time and date of the seminars.

7. A CAI summer workshop that is offered for graduate credit (5 hours) involving well-known professionals as lecturers and lots of "hands on" experience with CAI for the participants will do much to gain support

from the key areas of the University community, i.e., Administration, Faculty and Computer Center personnel.

8. At least three courses that take into account the use of CAI as a student, author and supervisor should be made a part of the University curriculum. Workshops alone will not provide the needed staff. The only sure way to get properly trained people is to train them at the University on a continuing schedule of courses.

III. AN IDENTIFICATION OF WHAT COST EFFECTIVENESS IS AND WHAT FACTORS SHOULD BE CONSIDERED IN EXAMINING THE COST/BENEFIT RATIO.

F. What follows is a description of a practical cost effectiveness process that is based on the assumption that amount learned and students saved are real cash value items.

COST EFFECTIVENESS

To date, the best example of the cost effectiveness of CAI at the University of Akron has taken place at a junior high school in a community just outside the city. Using just one terminal in a remedial reading program, the students participating in this program demonstrated an average of three months' growth for every month in this program as measured by the California Reading Achievement Test.

When one considers the fact that under previous instructional systems students in this group averaged less than one month's growth for every month in the system, the cost reduction is astonishing. Students are growing at a rate in their performance that is better than three times the expected rate. Hence, there is a cut in the cost of instruction by at least a factor of three. Recently this same application has been spread to several other elementary and secondary schools in the Akron area.

Another example of a promising cost-beneift ratio that has occurred at the University is in the area of freshmen composition. Not only has CAI lessened the failure rate previously established by this course, but it has brought students from the brink of failure to the honor grade level in this crucial freshman course. When you add the potential FTE that a four year program will generate from over one hundred full time students, you can see why our basic English program has become one of our CAI prizes.

Currently, Dr. Gerald Blumenfeld handles over 200 students a quarter in a self-paced, performance-based program that has been extremely effective. For example, on the mid term exam associated with this course, not one student fell below an 80% correct level on a 60-item test.

When you consider the lowering of the attrition rate, the increased performance, the savings in student and instructor time, and student-to-professor ratio that exists in the course described above one must wonder why so many institutions have

failed to take advantage of such a promising innovation. The reasons are many, and they are related to current disadvantages associated with CAI. Recently, an elementary mathematics program which provides diagnostic testing, tutorial and drill instruction, problem solving puzzles, spaced review, and comprehensive evaluations has been developed. This course is currently being tested by public school students, and will be available for release in late 1977.

G. DISADVANTAGES

The disadvantages of CAI can be put into two categories: those which are a result of the state of the art of CAI, and those inherent in CAI itself. These two categorical inconveniences are made up of the following subheadings:

1. STATE OF THE ART DISADVANTAGES

1. SOFTWARE

Unfortunately, problems surrounding software are often overlooked when CAI is being considered as an instructional method. Coursewriter and other CAI compilers are much like any other compiler. They must be maintained and continually updated. This means that:

i. changes in the existing system force changes to be made in the CAI system.

ii. as demands and sophistication increase, new problems are uncovered in the language and

corrections must be supplied. Part of this upgrading is due to the fact that the more that users explore the language, the more versatile they find it to be.

iii. the open-endedness of CAI languages enables the user to explore new horizons in coding techniques. As author expectations increase, if the language remains constant, coding problems emerge. Such a dynamic situation requires constant vigilance on the part of those who are responsible for software development and system patches. This constant state of change and correction, which is the mark of an emerging science, is nonetheless a cost to the system.

2. COURSEWARE

To date there exists a limited amount of courseware available for off-the-shelf purchase. Although this situation is improving, there is still a short supply of available courseware in many academic disciplines. At present time, the most effective off-the-shelf courseware appears to be those CAI courses which furnish drill and practice in the basic skill areas of reading, writing and arithmetic. Within the past few years, the will to survive has caused CAI users to begin to cooperate in order to offset the inefficiencies of total self development. Many CAI users are sharing courses they develop with one another. This has had a dramatic effect on the start up effectiveness of new CAI installations. Recently commercial vendors, such as IBM, have marketed CAI programs. Most of these programs

have been developed by CAI Users. The documentation and packaging necessitated by such marketing has brought about a standardization and portability of courseware that had not previously existed. It is the beginning of a widespread infiltration of CAI in both the manufacturing and education industries. This development will result in the elimination of the courseware liability.

3. EVALUATION

Another serious liability to CAI at this date is the lack of definitive data which points to subject matters that are most appropriately delt with through one or more types of CAI. Such research has been slow in coming, and it is this writer's contention that cost effectiveness studies of interrelationships between teacher and computer-based instructional systems must be undertaken to provide the needed guidance for future users of CAI. Some of the questions that should be pursued by such investigations are:

i. How does one ASSESS the relative worth of CAI based on its costs and its educational outcome?

ii. How does one determine whether a CAI program is becoming more or less effective as time passes?

iii. With what types of courses and/or populations is such instruction most or least effective?

The primary objective of such studies should be to provide data that will enable educational policy makers to make optimal decisions about instructional programs which do or do not involve computers as instructional aids.

4. PEOPLEWARE

Since courseware is not presently available in the quantities that CAI users desire, it must be developed in-house or by a contractor or by some other institution. Individuals with the skill and experience needed to profitably perform such development are in very short supply. Until this fact is realized, educators will not focus on the problem of providing the necessary trained cadre of CAI developers that the world so urgently needs. Instead, they will continue to assemble groups of well-intentioned but untrained enthusiasts who will not be able to develop quickly enough to meet the initial demand generated by CAI's first visit to the campus. In fact, conditions generated by such an oversight almost guarantee the demise of such an undertaking before it gets underway. It is difficult to imagine serious development of sophisticated, well-designed courseware being accomplished by a group of professionals who lack training or experience in

CAI courseware construction. The development problem is further complicated by the expectations generated by some policy makers who believe that existing staff can, on their own time, develop extensive CAI materials. Such expectations are rarely fulfilled. Without INCENTIVES to produce extensive CAI courses, the fate of CAI hangs in the hands of a few generous volunteers who are willing to expand great amounts of time on the development of courses for the sheer joy of perfecting the art. This missionary approach, while admirable will not deliver the kind of materials needed for the full development of CAI as an instructional system. If an in-house approach to developing needed courseware is to be successful, policy makers must accept the responsibility for granting the same kind of credit to faculty for CAI course development that they give to other types of academic efforts. Unfortunately, at the present time, several institutions at which attempts at an in-house CAI development have been tried, have indirectly punished those individuals who spend their time on CAI course development rather than on conventional publications. This kind of atmosphere does much to stifle the development of CAI courses and, in fact, has led to the demise of CAI systems at several universities. Proper recognition of faculty who participate

in CAI course development and reasonable royalties from publishers seems to be the best solution to the problem. It is a challenge to policy makers. Dare we develop a new reward system? If we do then both the availability of courseware and peopleware will be significantly incremented in a rather short period of time!

2. INHERENT DISADVANTAGES

The inherent disadvantages of CAI cover such things as cost, time, initial outlay as well as other practical considerations. However, when one considers the potential, investment in CAI seems to be well advised. Captial costs for hardware are low, but continuing costs for such things as system maintenance, operations, and program adaption are more substantial. In addition to these computing expenses there are other costs involved with Program Development, such as course material preparation and course implementation. These, too, can be considered "worth the investment", especially with the current "willingness to share" and vendor marketing practices that seem to exist within today's CAI environment. Overall, the present state of the art points the finger of "good decision" in the direction of CAI. Thus the inherent disadvantages are overcome by the fact that, given the condition that conventional instructional costs will continue to rise as they have over

the past ten years and CAI costs continue to drop as they have over the past ten years, then the cost of CAI on a per-pupil basis should be less than half the cost of comparable conventional instruction by 1981.

H. SUMMARY OF COST EFFECTIVENESS

ASSETS	LIABILITIES
1. Lowering of Student Attrition Rate.	1. Software Development.
2. Individualizing of Instruction	2. Continued Maintenance.
3. Increased Student and Faculty Performance.	3. Limited Availability of Courseware.
4. Savings in Student and Instructor Time.	4. Lack of Definitive Data of CAI's Optimal Utilization and Limits for Expectations.
5. Increased Teacher Productivity	5. Short supply of Trained Professionals in the Field of CAI.
6. Staff Savings.	6. Initial out of Pocket Expenses.
7. On demand availability of documented student performance.	

The question of CAI's cost effectiveness deals with two categories--assets and liabilities. Most of the assets deal with student and teacher performance. Most of the liabilities deal with time, money and personnel. Which of the two will be given more weight by a set of policy makers may be determined by how they answer the following

two questions:

1. Which matters most saving money or saving students?
2. Is effective education an expense or an investment?

IV. A PERSPECTIVE OF WHERE COMPUTER BASED INSTRUCTIONAL TECHNOLOGY IS GOING AND WHAT WILL BE REQUIRED TO GET THERE

1. THE FUTURE OF COMPUTER-BASED INSTRUCTION

In any blueprint for the future, one should start by reviewing the situation as it currently exists. In so doing, the logical path to the future can be shown starting from a familiar reference point - today - and proceeding to unknown projection point - tomorrow.

TODAY

Today CAI is delivered from a computer through some communication linkage to either typewriters, cathode-ray tubes or plasma tubes. Such systems allow the computer to deliver a great deal of information in print or graphic form; however, they do not provide the animation that one can get from a motion picture or television presentation.

THE DISTANT FUTURE

Today, television plays an important role in education, as does the computer. Unfortunately, at present, these two great delivery systems play separate and distinct roles in the education

industry. There is a missing link in the system. This link will connect the computer and the camera in such a way as to allow the computer to deliver to the T.V. screen that which the camera sees. The link of which this writer speaks is the videodisc. With such a videodisc support system, two-way full color T.V. systems could furnish a type of CAI that was envisioned by its early pioneers, but never realized. The problem of coding graphics on a line by line basis would no longer exist. The hardware which would make all of this possible already exists. However, at the present time, it is not either technologically or economically practical to mass produce this system for commercial use. A videodisc system as a regularly-manufactured product has recently been made available by Philips - MCA and plans and working models for new and different videodiscs are popping up almost monthly. At this time videodisc technology is still in a developmental stage, with videodiscs being developed for entertainment use. Instructional hardware and software for videodiscs are not yet available anywhere in the world today. Philips is very close to making such a disc available on a production basis and there is reason to believe that this will happen within the next two years i.e., by 1979. From a computer standpoint the idea is exciting because it will allow information in full color to be placed on information tracks in a dense pattern that is only two microns apart. (A micron is 1/1000 of a

millimeter.) The result is that such a disc could hold a great deal more information than is presently possible with magnetic storage components and therefore the amount of playing time that such a disc could provide would support most CAI systems. This innovation would make videodiscs the cheapest storage medium developed to date, provided the computer industry adopts the laser overlay and optical system ideas, instead of the mechanical and magnetic systems now in use. Once this idea is accepted, the production of a disc system which uses laser overlays to embed information by means of optical pickups, is assured. When this happens, the world of CAI will turn into a full color environment which will be as real or imagined as today's greatest cinematographers can make it. All of this will most certainly come about by the 1980's.

THE IMMEDIATE FUTURE

In the very near future, we will see a change in the type of communication systems that we are now using. Currently CAI users are dependent on uninterrupted transmission from a single control processor to a terminal site via some sort of cable or telephone connection. The problems generated by dependence on such communication are substantial and will continue to manifest their presence unless a different form of communication is provided. The means for doing so are at hand and they exist in a production mode today. Today, IBM's 3790 disc type of

storage system can act like a mini computer on site to the terminal area. This or some other dedicated storage system will communicate to a large CPU on an intermittent basis. Thus, the need for continual telephone communication is removed. With this independence, CAI, on a local basis, could be made almost 100% reliable and the true notion of consortium could become a practical reality. One large CPU could then be used as a central depository of courses and as a means for doing file updates for those who use the system. Since each site need transmit to the central CPU only on an intermittent basis, an almost limitless number of terminals and courses could be serviced from the centralized CPU. The economy of scale benefits of this system would do remarkable things for the cost effective ratios that would be gathered from individual CAI systems that could be scattered all over the globe. The link between local systems and the central CPU would most certainly be a communications satellite that would bounce the communications from each remote site to the central CPU. Today, the elements for creating such a system exist. Tomorrow, the CAI-TV link will be made. When one thinks of the possibilities that the combinations of such systems could provide, his mind becomes unbounded. What is real? What is imagined? It depends on your frame of reference. Let us hope that our minds can expand far enough to realize the great possibilities that such a system could provide for all mankind.

V. SUMMARY

FOR WHAT IT'S WORTH

As with everything in life, the true measure of the worth of CAI will be calculated from a measure of what the student receives in terms of increased rate, level and retention of learning. Whether CAI will get its chance to realize its promise depends on the spirit of the times. We are going through a period of trying to adjust an educational system that was designed for horse and buggy days to a jet age society. CAI is helping us come to grips with this problem. It will not succeed as long as substantial numbers of educators prefer the short, slow travel of outmoded systems to the enlarged world of today's dawning technology. The whole question comes down to the people who are the system. Are they capable? Are they inventive? Are they ready to jump into the future? Let us hope they are adventurous, for if they are not, we will continue to be a society that prefers to react to crises instead of one that prefers to prevent them.

APPENDIX

QUESTIONS ONE SHOULD ASK WHEN GETTING STARTED IN CAI

You will want to find out about . . .

THE COMPUTER SYSTEM

--Who manufactures it?

--How helpful is the vendor, and to what extent can he be expected to aid in the implementation of the system?

--What computer software, programs, or languages are being used to run the instruction?

--Who wrote them?

--Who maintains them?

--How much do they cost?

--Can they be altered? How easily? Who does that?

--How reliable is the software? The hardware?

--How many hours a day is the computer available?

--What kind of support does the central staff give? (is the installation dependent on a large multipurpose computer shared by many users)

--How good is the support? Who pays for it?

--What are the qualifications of these support persons?

--What kinds of terminals are used? How many?

--What is their speed and response time?

--How reliable are they?

--How are they connected to the computer?

--How much "core" or "memory" is required to run the CAI program?

--How much of this is devoted to communications software, how much to instructional software?

THE STUDENT USERS

--What have they learned?

--How do they like it? Is it better than what they had before? What did they have before?

--What don't they like about CAI?

--Is the terminal easy to use? Does it ever "break"?

THE TEACHER

--How are the students performing?

--What is the teacher's reaction to CAI?

--What problems do students experience in the mechanical aspect of the operation?

--To whom do they turn for help if they experience a problem?

--What kind of help do they get?

--Who advises them on student progress?

--Have they taken the CAI course (i.e., the instruction being given to their students) themselves? Why or why not?

--What would they change if they could?

THE INSTALLATION PLANNERS OR DESIGNERS

--How many terminals, how many students, what is the duration of each student's contact with the system each week?

--What material is being presented?

--What are the objectives? Are they being met?

--What is the overall cost? Is it worth it?

--What are the future plans?

The time spent in this effort will prove to be very valuable in enabling you to cut short development time where you can profitably use the experience of others. Also, it will give you an invaluable list of contacts with whom you will be able to share problems.